

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 2031265PC/ko	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/FI2003/000944	International filing date (day/month/year) 11-12-2003	Priority date (day/month/year) -
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant Nokia Corporation et al		

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 9 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
 - ☒ (sent to the applicant and to the International Bureau) a total of 4 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

- This report contains indications relating to the following items:

<input checked="" type="checkbox"/>	Box No. I	Basis of the report
<input type="checkbox"/>	Box No. II	Priority
<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/>	Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/>	Box No. VI	Certain documents cited
<input type="checkbox"/>	Box No. VII	Certain defects in the international application
<input checked="" type="checkbox"/>	Box No. VIII	Certain observations on the international application

Date of submission of the demand 07-06-2005	Date of completion of this report 17-03-2006
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Form PCT/IPEA/409 (cover sheet) (April 2005)

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: **Cover sheet**

International patent classification (IPC)

G03B 19/22 (2006.01)

G06T 5/50 (2006.01)

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Box No. I Basis of the report

1. With regard to the language, this report is based on:

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into _____,
which is the language of a translation furnished for the purposes of:
- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1 - 14 _____ as originally filed/furnished
- pages* _____ received by this Authority on _____
- pages* _____ received by this Authority on _____
- ☒ the claims:
- pages _____ as originally filed/furnished
- pages* _____ as amended (together with any statement) under Article 19
- pages* 15 - 18 _____ received by this Authority on 21 - 11 - 2005
- pages* _____ received by this Authority on _____
- ☒ the drawings:
- pages 1 - 2 _____ as originally filed/furnished
- pages* _____ received by this Authority on _____
- pages* _____ received by this Authority on _____
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
- ☐ any table(s) related to the sequence listing (*specify*): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
- ☐ any table(s) related to the sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>see supplemental box</u>	YES
	Claims	<u>1-3, 5, 8, 10, 13, 14, 23-26, 28, 33, 38</u>	NO
Inventive step (IS)	Claims		YES
	Claims	<u>1-38</u>	NO
Industrial applicability (IA)	Claims	<u>1-38</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Most relevant documents cited in the International Search Report:

D1: US6611289 B1

D2: EP0858208 A1

D1 discloses a digital camera and method where multiple images are acquired with at least two image capturing devices, which can be separately controlled (using different exposure times and other system parameters). In order to increase the dynamic range, a portion of a second image, acquired by a second image capturing device, is combined with a first image, which is acquired by a first image capturing device.

D2 also discloses a method and camera where images from at least two image capturing devices are combined in order to obtain a digital image with improved quality.

The applied invention relates to a method and imaging device for producing images of enhanced quality (compared with images taken by devices having a single image capturing device) by combining images acquired by at least two different image capturing devices, where at least one of the capturing devices has different light gathering capability, e.g. larger/smaller aperture size. The captured images are combined by using an averaging method for each pixel to be combined.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V., 1.

Novelty (N)	Claims:	<u>4,6,7,9,11,12,15-22,27,29-31,34-37</u>	YES
			YES
	Claims:		NO
			NO
Inventive step (IS)	Claims:		YES
			YES
	Claims:		NO
			NO
Industrial applicability (IA)	Claims:		YES
			YES
	Claims:		NO
			NO

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: BOX V

Referring to claims 1 and 25:

According to claim 1 an image with enhanced quality is obtained by utilizing images acquired by at least two different image capturing devices, where at least one of the at least two image capturing devices has a different light gathering capability. The at least two different images are combined by using an averaging method.

D1 (see for example column 9, row 41-52 and claim 5) discloses that images acquired by two different image capturing devices are utilized in order to obtain an enhanced (increased dynamic range) image. The dynamic range is increased because one of the image capturing devices has a different light gathering capability (one is a B/W sensor while the others detect one primary color each, see column 9, row 4-27).

Also, D2 (see claim 1 and page 5, row 33-41) discloses a method and device for combining images acquired with image capturing devices having different light gathering capabilities (different depth of field).

In the letter received at 21-11-2005, the applicant states that none of D1, D2 discloses that an averaging method is used in the combining procedure. However, using some kind of averaging method when combining images is considered to be a standard procedure. Also, using an averaging method on a pixel-by-pixel basis is explicitly stated in D2 (see page 4, row 55-58).

In view of the aforementioned, the invention according to claim 1 lacks novelty.

The argumentation regarding claim 1 is also valid for claim 25. Therefore, the invention according to claim 25 lacks novelty.

Referring to claims 2-24, 26-38:

The invention according to claims 2 and 26 lacks novelty, because D1 (see claim 5) describes that a portion of a second image is utilized.

The invention according to claims 3 and 33 lacks novelty, because D1 (see claim 5) and D2 (see claim 1) clearly state that the images are combined in order to obtain an enhanced image.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

The invention according to claim 5 lacks novelty, because D2 (see page 5, row 33-41) describes that differences in depth of field (focal length and aperture) can be utilized in order to obtain an enhanced image.

The invention according to claims 8 and 28 lacks novelty, because said claim only describes the basic and fundamental operation of a digital image producing device, namely to produce an image proportional to the electric signals received from an image sensor. The above is also disclosed in D1 (see for example column 1, row 23-32 and figure 3).

The invention according to claim 10 lacks novelty, because D1 (see figure 3 and 4A) and D2 (see figure 1b) illustrate a device having four lenses.

The invention according to claims 13 and 14 lacks novelty, because D2 (see for example page 6, row 13-17) describes at least three image capturing devices each having one of the color filters mentioned in claims 13 and 14.

The invention according to claim 23 lacks novelty, because D1 (see figure 3) and D2 (see figure 1b) disclose that each image capturing device comprises a lens arrangement.

The invention according to claims 24 lacks novelty, because D1 (see column 9, row 43-46) discloses that the image capturing devices can have different exposure times.

The invention according to claim 38 lacks novelty, because D1 (see figure 3 and column 3, row 62-67) and D2 (see figure 1a and page 3, row 6-8) disclose that each image capturing device produces images with a lens arrangement on its own.

Referring to claims 4,6,7,9,11,12,15-22,27,29-32,34-37:

Dependent claims 4,6,7,9,11,12,15-22,27,29-32,34-37 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step. Said claims only relate to obvious and trivial details, such as using different types of sensors, e.g. Bayer and infra-red, and measuring parameters,

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In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

e.g. exposure time and using weighted mean calculations, which are well known in the art and therefore obvious for a person skilled in the art to incorporate into the inventions according to D1 and/or D2 without using any inventive skills.

Hence, the invention according to claims 1-3,5,8,10,13,14,23-26,28,33,38 lacks novelty. The invention according to claims 1-38 is not considered involving an inventive step. The invention according to claims 1-38 has industrial applicability.

Novelty (N) claims: 4,6,7,9,11,12,15-22,27,29-31,34-37 YES

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

The term "small" used in claim 4 is vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear (Article 6 PCT).

Claims (Amended 21.11.2005)

1. An imaging device comprising at least two image capturing apparatus, each apparatus being arranged to produce an image comprising pixels, the apparatus being configured to utilize at least a portion of the images produced with different image capturing apparatus with each other to produce an image with an enhanced image quality characterized in that at least one image capturing apparatus has a different light gathering capability and that the image produced by the at least one apparatus is used for enhancing the dynamic range of the image produced with the other image capturing apparatus by combining at least a portion of the images using an averaging method for each pixel to be combined.
2. The device of claim 1, characterized by the apparatus being configured to analyse the images produced with the image capturing apparatus and to determine which portions of an image to utilize.
3. The device of claim 1, characterized by the apparatus being configured to combine at least a portion of the images produced with different image capturing apparatus with each other.
4. The device of claim 1, characterized in that at least one image capturing apparatus has a small aperture.
5. The device of claim 1, characterized in that at least one image capturing apparatus has higher aperture than other apparatus.
6. The device of claim 1, characterized by the apparatus being configured to utilise a weighted mean method for each pixel to be combined.
7. The device of claim 1, characterized in that at least one image capturing apparatus comprises a polarisation filter.
8. The device of claim 1, characterized in that the image capturing apparatus comprise a lens system and a sensor array configured to produce electric signal and that the device comprises a processor operationally connected to the sensor arrays and configured to produce an image proportional to the electrical signal received from the sensor arrays.
9. The device of claim 8, characterized in that the device comprises a sensor array divided between at least two image capturing apparatus.
10. The device of claim 1, characterized by the device comprising a lenslet array with at least four lenses.

11. The device of claim 8, characterized in that the device comprises a sensor array and four image capturing apparatus, each apparatus using one lens from the lenslet array and a portion of the sensor array.

12. The device of claim 9, characterized in that three image capturing apparatus are configured to produce a colour image; that the fourth image capturing apparatus is configured to produce an image; and that the device comprises a processor configured to combine at least a portion of the images with each other to produce an image with an enhanced image quality.

13. The device of claim 10, characterized in that the three image capturing apparatus each comprise an unique colour filter from a group of filters red, green or blue.

14. The device of claim 10, characterized in that each of the three image capturing apparatus comprises a unique colour filter from a group of filters cyan, magenta or yellow.

15. The device of claim 12, characterized in that the fourth image capturing apparatus comprises a Bayer matrix.

16. The device of claim 12, characterized in that the fourth image capturing apparatus produces infra-red images.

17. The device of claim 1, characterized in that at least one image capturing apparatus is shielded for producing a dark reference.

18. The device of claim 1, characterized in that at least one image capturing apparatus is used for measuring white balance.

19. The device of claim 1, characterized in that at least one image capturing apparatus is used for measuring exposure parameters.

20. The device of claim 1, characterized in that the fourth image capturing apparatus comprises a polarization filter.

21. The device of claim 1, characterized in that the fourth image capturing apparatus produces images from which a specific light polarization direction has been removed.

22. The device of claim 1, characterized in that each image capturing apparatus comprises a different aperture and is dedicated to a different spectral band.

23. The device of claim 1, characterized in that each image capturing apparatus comprises a lens arrangement.

24. The device of claim 1, characterized in that at least one image capturing apparatus is configured to use a different exposure time compared to other apparatus.

25. A method of creating an image file in an imaging device, comprising producing images comprising pixels with at least two image capturing apparatus, utilising at least a portion of the images produced with different image capturing apparatus with each other to produce an image with an enhanced image quality characterized by producing images with image capturing apparatus of a different light gathering capability and combining at least a portion of the images using an averaging method for each pixel to be combined.

26. The method of claim 25, characterized by analysing the images produced with the image capturing apparatus and determining which portions of the images to utilize.

27. The method of claim 25, characterized by the combining is made using a weighted mean method for each pixel to be combined.

28. The method of claim 25, characterized by producing images with image capturing apparatus comprising a lens system and a sensor array configured to produce an electric signal and processing the images proportional to the electric signal with a processor operationally connected to the sensor arrays.

29. The method of claim 25, characterized by producing images with a sensor array and four image capturing apparatus, each apparatus using one lens from the lenslet array and a portion of the sensor array.

30. The method of claim 29, characterized by producing a colour image with three image capturing apparatus, producing an image with the fourth image capturing apparatus and combining at least a portion of the images with each other to produce an image with an enhanced image quality.

31. The method of claim 30, characterized by producing a colour image with the fourth capturing apparatus by using a Bayer matrix filter.

32. The method of claim 30, characterized by producing an infra-red image with the fourth capturing apparatus.

33. The method of claim 25, characterized by combining at least a portion of the images produced with different image capturing apparatus with each other.

5 34. The method of claim 25, characterized by using at least one image capturing apparatus for producing a dark reference.

35. The method of claim 25, characterized by using at least one image capturing apparatus for measuring white balance.

36. The method of claim 25, characterized by using at least one image capturing apparatus for measuring exposure parameters.

10 37. The method of claim 25, characterized by using at least one image capturing apparatus for producing images from which a specific light polarization direction has been removed.

38. The method of claim 25, characterized that each image capturing apparatus produces images with a lens arrangement of its own.

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